

# **A Preliminary Survey of the Fern Flora of Langkawi Islands**

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## **Abstract**

A survey of the fern flora of Langkawi Islands is presented, including a summary of their habitats and ecology. Of the 145 infrageneric taxa recorded from the islands, 7 are introduced or naturalized and 6 are presumed rare or endemics. Species are listed for both indigenous and secondary plant communities.

## **Introduction**

Langkawi, the natural paradise in the northwestern coast of Peninsular Malaysia is noted for its sun, unspoilt white sandy beaches and clear blue water. This group of islands lie between 22 and 54 km off the coast of Perlis, the northern-most state of Peninsular Malaysia, and 112 km north of Penang. Compared to the mainland, these 99 islands are relatively free of any kind of pollution. Only the blasting of limestone in the Kubang Badak Quarry, may have caused considerable noise and dust pollution within its operational area. Traffic density is light and the only noticeable pollution is smoke from the burning padi straws and rice husks during harvesting season. The white sandy beaches of Pantai Cenang, Tanjung Rhu and Teluk Barau are only a few of the major tourist attractions of Langkawi. The beaches have been free of oil spillage from ships, rubbish or sewage. The islands are covered with gently rolling hills of lush tropical rainforest. They are sheltered from the effects of tropical storms by the chains of islands not very far from the shore lines of the main island. Langkawi is one of the great natural assets of Malaysia.

## **Geography and Geology**

Langkawi comprises six moderate sized islands and ninety-three other small islets (Fig. 1). These islands, formed of and flanked by towering masses of limestone as well as quartzite and granite are situated at  $6^{\circ}10'$  to  $6^{\circ}27'$  and  $99^{\circ}37'$  to  $99^{\circ}56'$  and lie about 48 km off the coast of mainland Kedah. Langkawi Island is by far the biggest and more important, with an area of about 939 square km. Next in size is Dayang Bunting Island, 24 km long, with Tuba Island on the east, separated by a strait so narrow that it appears like a river. West of Dayang Bunting is Singa Besar Island, Beras Basah Island and many islets. On the southwest of Langkawi Island is Rebak Besar and Tepur Islands; on the east Langgun and Tembus Islands, while on the southeast is Timun Island, separated from the main island by the deep and narrow Strait of Panchor. With the exception of Langkawi, Dayang Bunting and Tuba, the other islands are either uninhabited or support a handful of temporary occupants of fishermen.

The centre of Langkawi Island, composed of granite and dominated by Gunung Raya — the highest peak on the island, is almost entirely primary forest with few

access routes into it. It is the only Virgin Jungle Reserve (VJR) with an area of 149 ha demarcated in Langkawi (Putz, 1978). The primary forest is undisturbed and representative of the forest here. The slopes are characteristically steep and severely drained. Large trees are found in scattered patches where milder slopes have allowed deeper soil to develop. North of Gunang Raya towards the coastal strip known as Pantai Pasir Hitam, is secondary forest, much of which has been cleared to make way for settlement and a cement factory in Kampung Ewa. Towards the northwest, there is a long serrated quartzite ridge with about fifteen peaks clad with virgin jungle which is appropriately called "Gunung Machinchang", the Chopped Mountain.

The middle-west and centre of Langkawi Island consist solely of granite. Again there is granite in Dayang Bunting, Tuba and Bumbun islands. Fine crystalline marble is found at the northeast end of Dayang Bunting, Rebak, Tepur, Beras Basah and Singa Besar islands and numerous islets in the vicinity are composed of quartzite and shale.

Limestone rock least affected by the granite is seen in certain islets such as Jong and Kora as well as in the bigger islands such as Langgun, Tanjung Dinding, Timun, Dayang Bunting and the northeast coast of Langkawi. The limestone is part of the carboniferous limestone formation that is also found in Sumatra, north of Peninsular Malaysia, Thailand, Indochina and Burma. The limestone hills rise from flat or undulating plains often with steep or over-hanging cliffs and some of them rise sheer from the water's edge where part of or even the entire coast is entirely limestone.

### Climate

The tropical islands of Langkawi share the same climatic patterns with northern Kedah in the Malay Peninsula. Day temperature is high and lies within a fairly narrow range of 35°–37° (Jones, 1978). Water temperature is around 26°–28°.

Rainfall recorded for ten years (1965–1975) from four districts average 260 cm annually (Jones, 1978). The islands experience a distinct and more severe dry season from November/December to March than is associated with the most part of Peninsular Malaysia. This corresponds to the northeast monsoon when the average monthly rainfall for January and February hardly exceeds 5 cm compared with an average for the year of about 260 cm. Two wet seasons occur during the change of monsoons, that is, during April and May when the monthly rainfall averages over 22.5 cm, and August to October when the average reaches over 27.5 cm per month. Between these two wet seasons occurs another dry period in June and July corresponding to the southwest monsoon when the rainfall averages between 17 and 20 cm.

### Observations

Langkawi has been the subject of many general biological investigations in the last hundred years or so (Maxwell, 1887; Ridley, 1908 and 1912; Henderson, 1939; Igo and Koike, 1966; Wilcocks, 1969; Yadab and Ratnasabapathy, 1974; Balgooy *et al.*, 1977; Chin, 1977; Kuthubutheen, 1981). However comprehensive accounts of any particular group of plants especially ferns, are still lacking. Sporadic collections have been made from time to time and among the notable fern collectors of the islands are M.R. Henderson, H.C. Robinson, C. Curtis, Md. Haniff, Md. Nur, H.N. Ridley, R.E. Holttum and recently Chin, R. Jaman and A. Bidin. Most of the specimens are kept at the herbaria in Singapore (SING), The Universiti Kebangsaan Malaysia Bangi (UKMB), University of Malaya (KLU) and Kew (K).

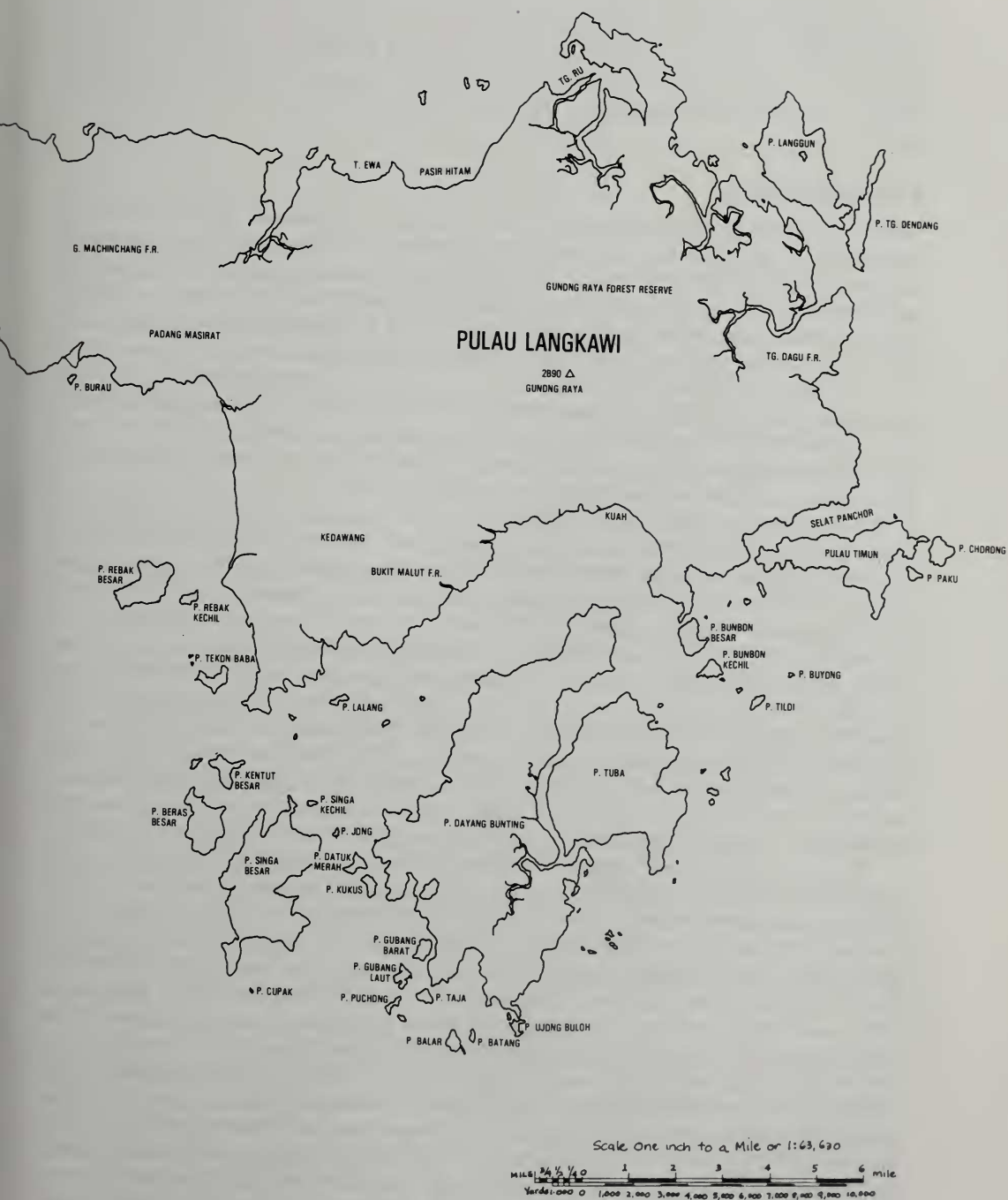


Fig. 1. Map of Langkawi Islands.

## Present Account

The present survey is based on the results of a number of field trips carried out in January, February, April and May 1986 by the author and a number of field assistants under a project sponsored by the Universiti Kebangsaan Malaysia in Bangi, as well as on observations of herbarium specimens deposited at the University of Malaya, The Universiti Kebangsaan Malaysia, Bangi and The Royal Botanic Gardens, Kew.

## Field Observations

A striking feature of the scenery in Langkawi is the occurrence of two main types of vegetation, limestone and granite. The vegetation of the limestone is primary forest, and only slightly disturbed. Only where the area has been disturbed by quarrying and similar activities does secondary forest appear. Much of the limestone cliffs are honeycombed with caves. On exposed headlands of Langkawi and Dayang Bunting islands as well as the entire surfaces of some of the rocky islets, the vegetation is often stunted and reduced, the rocks being covered with grasses, bamboos and occasional stunted trees. Only in areas sheltered from the wind is the vegetation more luxuriant with a denser growth of larger trees. Among the common ferns found on the rocky headlands with constant exposure to sea sprays are *Davallia denticulata*, *Pyrrhosia* spp., *Drynaria sparsisora* and *Asplenium* spp.

The granite ridges on the other hand have a much softer outline, the vegetation is markedly more luxuriant, consisting of many trees, shrubs, climbers and epiphytes.

Most of the alluvial areas of the coastal plains of Langkawi Island have been cleared and cultivated, and sometimes abandoned. Here the most abundant and conspicuous of all the sun-loving ferns are the well-known "Resam" *Dicranopteris linearis* and "Ribu-ribu" *Lygodium microphyllum*. *D. linearis* covers considerable tracts right up to the edges of the forest where it produces dense thickets, while *L. microphyllum* scrambles over other plants, and through the grasses. The rice-fields abound with *Marsilea crenata*, *Azolla pinnata* and *Ceratopteris thalictroides*. *C. thalictroides* is also commonly found in irrigation canals. In the mangrove, which covers more than 1474 hectares (nearly 8 per cent of the Island's land surface), the two species of *Acrostichum*, namely *A. aureum* and *A. speciosum* are abundant. On earth banks where exposure to sunlight is maximal, *Nephrolepis biserrata* and *Blechnum orientale* are common.

The plain to the north of Kuah is largely rubber plantation and scattered settlement areas. Here, the common ferns are both terrestrial and epiphytic. *Nephrolepis biserrata* and *Stenochlaena palustris*, with their ability to reproduce vegetatively, flourish. Patches of *D. linearis* are everywhere, especially where the rubber canopy is thin. *Platycerium coronarium*, *P. holttumii*, *Goniophlebium persicifolium*, *Davallia denticulata*, *Drynaria sparsisora*, *D. rigidula*, *Drymoglossum piloselloides*, *Asplenium nidus* and *Vittaria ensiformis* are commonly found as epiphytes on the trunks of *Hevea brasiliensis* as well as on other trees by the Kuah-Kisap Road. *Doryopteris ludens*, *Adiantum latifolium* (introduced from Tropical America but naturalised and widespread not only in Langkawi but also all over Peninsular Malaysia) and *Microlepia speluncae* are abundant on stream banks in the rubber plantations. Besides the two species of *Platycerium* mentioned, the new species *Platycerium platylobum* (Bidin and Jaman, 1986) is only found on this plain, although uncommon. *Helminthostachys zeylanica* and *Schizaea digitata* are very common in lightly shaded areas of the plantation, growing among the grasses. The aerial part of the former is eaten as a vegetable while the rhizomes of both species are used alone or by mixing with other herbs in traditional medicines, supposedly as an aphrodisiac. The most popular vegetable fern (pucuk paku) among the locals is *Stenochlaena palustris*. The reddish juvenile frond

is eaten raw or cooked with coconut milk. The fern is abundant in open areas such as settlements, inhabiting wet places, especially stream banks.

Along the tracks leading to "Telaga Tujuh" (Seven Wells) (situated at the extreme western end of Langkawi Island) and Gunung Raya (the highest point on the Island overlooking the town of Kuah) the presence of *Pteris scabripes* with its whitish streaks near the frond margins is very conspicuous. The fern has also been observed on other parts of Langkawi Island but not on any other islands in the group.

Gunung Raya, a granite peak situated in the middle of Gunung Raya Forest Reserve is highly accessible. Most of the collections were made here. It is extremely rich in *Trichomanes*, *Hymenophyllum*, *Asplenium* and *Bolbitis*. *Bolbitis malaccensis* is elsewhere known only from one collection in Peninsula Thailand and from Tioman Island, on the eastern side of Peninsular Malaysia. *Microlepia strigosa* is found at the summit of Gunung Raya as well as the foot of Malut Hill (c. 100 m) and the collections made constitute the third location for the species recorded for Peninsular Malaysia. Among the members of the family Thelypteridaceae, the genus *Christella* is present from lower elevations (*C. papilio*) right through to the summit of Gunung Raya (*C. subpubescens*).

*Pseudodrynaria coronans* is collected from the Gunung Raya Forest Reserve, near the summit. The plant has its distributional area on the Asian mainland.

In Langkawi and Dayang Bunting it is observed that the sporophyte of some species of ferns (*Cheilanthes tenuifolia* and *Adiantum philippense*) perennate during the dry season especially in January and February by means of their rhizome while the fronds completely die down. Other species maintain at least a few of their leaves in an extremely dehydrated but living state, e.g. *Pyrrosia penangiana* and *Humata pectinata*, both of which are ferns of the limestone rock.

*Drynaria bonii* (a new record for Peninsular Malaysia) is found in Langgun Island only, living epiphytically on stunted trees or on limestone rocks with direct exposure to sunlight and sea sprays. Records at herbaria show that the plant is distributed mainly in Thailand as well as in Indo-China.

Much of Timun Island is inaccessible and the common ferns found on the limestone cliffs are *Adiantum stenochlamys*, *A. caudatum*, *A. philippense*, *Tectaria variolosa* (probably the only location for Malesia (Holtum, pers. comm., 1986, Holtum, 1985), *Drynaria sparsisora* and *Davallia denticulata*.

The genus *Trichomanes* is abundant in Langkawi with eight species, most of them collected in the Gunung Raya Forest Reserve vicinity.

Of the fifteen genera in Thelypteridaceae in Malaya (Holtum, 1980), six are found in Langkawi. All are found in the granite area and mostly in the lowlands. *Pro-nephrium* is confined to the lowlands only whilst *Amphineuron* and *Christella* are the ferns of lower elevations as well as the mountains. The mountain species are *Amphineuron immersum* and *Christella subpubescens* — both found near the summit of Gunung Raya.

Among the Dennstaedtiaceae, *Lindsaea* (7 spp.) *Pteris* (7 spp.), *Asplenium* (9 spp.) *Tectaria* (5 spp.) are well represented in Langkawi. *Lindsaea* which prefers moist deep shade, is common near the many streams in Gunung Raya Forest Reserve, whilst *Pteris*, *Asplenium* and *Tectaria* inhabit a variety of habitats. As for *Tectaria*, a brief mention should be made of two lowland species namely *T. brachiata* and *T. variolosa*, wrongly united by Holtum (1981b; 137). *T. brachiata* is widely distributed on granite in light shade in Langkawi: it is common in rubber plantations in Kisap as well as in forested areas along trails where the canopy is slightly open. It has a distributional area from NE. India to S. China and Taiwan, Thailand, Vietnam, northern Malaya and Jaya. Holtum (1981b) reported that the species is adapted to a climate with a seasonal dry period, which Langkawi certainly has. It would be interesting to see

if the species is present on Tioman Island on the eastern side of Peninsular Malaysia which has a similar climate. *T. variolosa*, a limestone fern which occurs from NE India southwards into Burma, Thailand and Vietnam is found in Langkawi on limestone cliffs and in crevices by the sea on Timun Island. It is a new record for Peninsular Malaysia.

## Ferns of Economic Importance

### Ornamentals

Some of the ferns of Langkawi have also found their way into homes and gardens. Among the popular species are *Asplenium nidus*, *A. phyllitidis*, *Platycerium coronarium*, *Microsorium punctatum* and *Adiantum stenochlamys*. Quite a number of ornamental ferns which are not of local origin are also popular as pot as well as garden plants. These are *Adiantum trapeziforme*, *A. peruvianum*, *A. mathewsianum*, *A. tenerum*, *A. capillus-veneris* and *Nephrolepis biserrata* var. *exaltata*. All are Tropical American ferns which flourish in Langkawi as well as in other parts of the country and which sometimes escape from cultivation and become part of the natural vegetation.

### Other Uses

In the daily life of the Malays in Langkawi, the fern *Lygodium* has a variety of uses. The long climbing rachises are used as twine and said to be long-lasting. Peelings from the rachises are used to make handbags, purses, mats and fish traps.

## List of Ferns Collected and Recorded from Langkawi Islands

The following list of ferns is arranged systematically. For each species the scientific name and the original author with its reference is given. Collection numbers and localities are cited: PL numbers refer to specimens collected during the course of the studies while specimens from herbaria and their collectors are mentioned also. Vernacular names are given where known.

The classification adopted follows Holttum (1968) and his subsequent reappraisal of the families Gleicheniaceae, Schizaeaceae, Cyatheaceae and Thelypteridaceae in Flora Malesiana (1959, 1963, 1978, 1981a). Names of *Tectaria* follow Holttum (1981b and 1985), and of *Lindsaea* follow Kramer (1971). Materials I have not seen are indicated by relevant literature citations, while records based upon field identification by the author without voucher specimens being collected are indicated as sight records. All materials collected are lodged in UKMB and duplicates in K (where indicated).

### OPHIOGLOSSACEAE

*Helminthostachys zeylanica* (Linn.) Hook., Gen. Fil. t.47b. 1840.

Paku tunjuk langit; akar paku.

PL 78: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 40 m elevation. UKMB, duplicate at K.

### MARATTIACEAE

*Angiopteris evecta* (Forst.) Hoffm., Comm. Soc. Reg. Gott. 12: 29, t.5. 179b.

Paku gajah.

PL 122: Singa Besar Island. Terrestrial, in deep shade, c. 5 m elevation. UKMB.

PL 281: Gunung Raya Forest Reserve; Genting Palas, Terrestrial, on slope, in deep shade, c. 550 m elevation. UKMB, duplicate at K.

### SCHIZAEACEAE

*Schizaea dichotoma* (L.) J.E. Smith, Memb. Acad. Turin 5: 442. t.9. 1793; Holttum 1959: 41.

Paku tumbak; paku jarum.

No. 7145. *Md. Haniff & Md. Nur*. Gunung Raya. Terrestrial. 13 November 1921. K.

*Schizaea digitata* (L.) Swartz, Syn. Fil.: 150, 380. t.4. f.1. 1896; Holttum 1959: 41. Janggut adam; misal ikan keli.

PL 148: Road junction of Kampong Buta and Kampong Kubang Badak. Terrestrial, in light shade, c. 90 m elevation. UKMB.

PL 282: Gunung Raya Forest Reserve; Genting Palas. Terrestrial, in light shade, c. 550 m elevation. UKMB, duplicate at K.

Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 40 m elevation. Not collected.

*Lygodium polystachyum* Wall. ex Moore, Gard. Chron. 1859: 671; Holttum 1959: 46.

PL 30: Bukit Malut Forest Reserve. Terrestrial and scrambling, in light shade, c. 30 m elevation. UKMB, duplicate at K.

PL 113: Road to Kuala Temoyong. Terrestrial, in light shade, c. 10 m elevation. UKMB.

PL 191: Bumbun Besar Island. Scrambling on bushes, exposed, c. 20 m elevation. UKMB.

PL 257: Selat Panchor Forest Reserve; track to Tanjung Apau. Terrestrial, in light shade, c. 110 m elevation. UKMB.

*Lygodium microphyllum* (Cav.) R. Brown, Prod. Fl. Nov. Holl: 162. 1810; Holttum 1959: 47.

Ribu-ribu selada; ribu-ribu; salada.

PL 115: Kedawang; Kampong Lubuk Buaya. Terrestrial, in light shade, c. 50 m elevation. UKMB, duplicate at K.

*Lygodium flexuosum* (L.) Sw., Schrad. J. Bot. 1800(2); 106. 1801; Holttum 1959: 53. Akar sidin; ribu-ribu gajah; darai paya.

PL 128: Seven Wells, by trackside. Scrambling, in light shade, c. 100 m elevation. UKMB.

PL 180: Kisap. Terrestrial, on roadside, exposed, c. 30 m elevation. UKMB, 2 sheets.

*Lygodium flexuosum* (L.) Sw. X *Lygodium salicifolium* Presl; Holttum 1959: 53.

PL 166: Kampong Sungai Taru. Scrambling on river bank, exposed, c. 20 m elevation. UKMB.

PL 40: Kisap; Boon Siew Estate. Scrambling, exposed, c. 40 m elevation. UKMB.

*Lygodium salicifolium* Presl, Suppl. Pterid.: 102, 1845; Holttum 1959: 57.

No. 2739. E.A. Turnau, 5 May 1961. K.

H.C. Robinson. Dayang Bunting Island. Terrestrial. November 1916. K.

PL 29: Bukit Malut Forest Reserve. Terrestrial, scrambling on *Tremma*, by roadside, in light shade, c. 30 m elevation. UKMB, duplicate at K.

PL 181: Gunung Raya Forest Reserve: Lubuk Semilang. Terrestrial, scrambling, in light shade, c. 40 m elevation. UKMB, duplicate at K.

PL 226: Kisap; Boon Siew Estate, near Kedah Marble Factory. Terrestrial, scrambling, in light shade, c. 40 m elevation. UKMB.

*Lygodium circinnatum* (Burm.f.) Sw., Syn. Fil.: 153. 1806; Holttum 1959: 59.

Paku jari merah; ribu-ribu duduk; ribu-ribu bukit.

PL 183: Kisap; Kuala Kisap. Scrambling, in light shade, c. 5 m elevation. UKMB.

### GLEICHENIACEAE

*Dicranopteris linearis* (Burm.f.) Underw., Bull. Torr. Bot. Cl. 34. 249: 1907. var. *linearis*; Holttum 1959: 33.

Resam.

PL 92: Klebang-Ulu Melaka Road. By roadside. Terrestrial, exposed, c. 50 m elevation. UKMB, duplicate at K.

PL 185: Kisap; Kuala Kisap. Terrestrial, in light shade, c. 5 m elevation. UKMB.

*Dicranopteris speciosa* (Presl) Holtt., Reinwardtia 4: 273. 1957; Holttum 1959: 32.

PL 175: Gunung Raya Forest Reserve: Lubuk Semilang. Terrestrial, in light shade, c. 40 m elevation. UKMB.

### HYMENOPHYLLACEAE

*Hymenophyllum denticulatum* Sw., Schrad. Journ. 1800 (2): 10. 1801.

No. 7168. Md. Haniff & Md. Nur. Gunung Raya. Epiphyte. 13 November 1921. K.

No. 7051. Md. Haniff & Md. Nur. Gunung Raya. Epiphyte. 13 November 1921. K.

*Trichomanes digitatum* Sw., Syn. Fil. 370. 1806.

No. 7122. Md. Haniff & Md. Nur. Gunung Raya. Epiphyte. 13 November 1921. K.

PL 134: Gunung Raya Forest Reserve; Durian Perangin Waterfall. On rock, in light shade, c. 200 m elevation. UKMB.

*Trichomanes proliferum* Bl., Enum. Pl. Jav. 224. 1828.

No. 1064. Md. Haniff. Telaga Tujuh. Epiphyte. 18 September 1914. K.

*Trichomanes pallidum* Bl., Enum. Jav. 225. 1828.

PL 217: Summit of Gunung Raya. On rock, in streambed, in deep shade, c. 950 m elevation. UKMB.

*Trichomanes bipunctatum* Poir., in Lamarck, Encycl. 8: 60. 1808.

PL 202: Gunung Raya Forest Reserve; Genting Palas. On rock, in light shade, c. 800 m elevation. UKMB, duplicate at K.

*Trichomanes latemarginale* Eaton, Proc. Am. Acad. 4: 111. 1859.

No. 15700. M.R. Henderson. Adang Island. Epiphyte. 1911. K.

*Trichomanes javanicum* Blume, Enum. Pl. Jav. 224. 1828.

No. 2433. C. Curtis. Machinchang. Epiphyte. February 1899. K.

No. 15699. M.R. Henderson. Adang Island. Epiphyte. 1911. K.

No. 15672. M.R. Henderson. Seven Wells. Epiphyte. 1911. K.

*PL 21*: Bukit Malut Forest Reserve. Terrestrial, in deep shade, c. 160 m elevation. UKMB.

*PL 264*: Gunung Raya Forest Reserve; Sungai Kelian. On rock, in deep shade, c. 150 m elevation. UKMB.

*Trichomanes maximum* Bl., Enum. Pl. Jav. 228. 1828.

*No. 15484. Md. Haniff & Md. Nur.* Gunung Raya. February 1911. K.

*PL 273*: Gunung Raya Forest Reserve; Sungai Kelian. On mossy rock in the middle of Sungai Kelian, in deep shade, c. 460 m elevation. UKMB, duplicate at K.

*Trichomanes obscurum* Bl., Enum. Pl. Jav. 227. 1828.

*PL 209*: Near summit of Gunung Raya. Terrestrial, in deep shade, c. 900 m elevation. UKMB, duplicate at K.

### CYATHEACEAE

*Cyathea contaminans* (Hook.) Copel., Phil. J. Sci. 4c: 60. 1909; Holttum 1963: 135.

*PL 86*: Kisap; Boon Siew Estate. Terrestrial, in light shade, near stream, c. 40 m elevation, UKMB, duplicate at K.

*Cyathea borneensis* Copel., Phil. J. Sci. 6: 135. 1911; Holttum 1963: 110; 1968: 631.

*PL 62*: Near summit of Gunung Raya. Terrestrial, in deep shade, c. 900 m elevation. UKMB, duplicate at K.

*PL 67*: Gunung Raya Forest Reserve; track to summit. Terrestrial, in deep shade, c. 700m elevation. UKMB.

*Cyathea glabra* (Bl.) Copel., Phil. Sci. 4c: 35. 1909; Holttum 1963: 120.

*PL 93*: Gunung Raya Forest Reserve; Lubuk Semilang, near pump-house. On streambank in deep shade, c. 50 m elevation. UKMB, duplicate at K.

*PL 263*: Gunung Raya Forest Reserve; Sungai Kelian. Terrestrial, in deep shade, c. 150 m elevation. UKMB, duplicate at K.

*PL 165*: Gunung Raya Forest Reserve; Lubuk Semilang. Terrestrial, in deep shade, c. 40 m elevation. UKMB, 2 sheets.

### POLYPODIACEAE

*Platynerium coronarium* (Koenig) Desv., Prodr. 213. 1827.

Rumah langsuyar.

*PL 117*: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade, c. 40 m elevation. UKMB.

*Platynerium holttumii* D. Jonch. & Hennipm., Brit. Fern Gaz. 10, 3. 116: 1970.

*PL 79*: Kisap; Boon Siew Estate: Epiphyte on *Hevea brasiliensis*, in light shade, c. 40 m elevation. UKMB.

*PL 176*: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade, c. 40 m elevation. UKMB.

*PL 150*: Kisap; Boon Siew Estate (near Kedah Marble Factory). Epiphyte on *Hevea brasiliensis*, in light shade, c. 20 m elevation. UKMB, 2 sheets.

*Platynerium platylobum* Aziz Bidin & Razali Jaman, Gard. Bull. 39(2). pl. 1 & 2. 1986.

*PL 149*: Kampong Padang Lunas. Epiphyte on *Hevea brasiliensis*, in light shade, c. 30 m elevation. UKMB.

PL 124: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade, c. 50 m elevation. Endemic. UKMB.

*Platyserium* sp. (unidentified).

PL 11: Bukit Malut Forest Reserve; near proposed dam site. On fallen tree, in light shade, c. 100 m elevation. Endemic. UKMB.

*Pyrrosia adnascens* (Sw.) Ching, Bull. Chin. Bot. Soc. 1: 45. 1935. (Hovenkamp (1986) places both *P. adnascens* and *P. varia* as synonyms of *P. lanceolata* (L) Farwell). Sakat batu; tetumpang.

PL 37: Bukit Malut Forest Reserve; near beach. Epiphyte, in light shade, c. 2 m elevation. UKMB.

PL 169: Machinchang Forest Reserve; Tanjung Datai. Epiphyte, in light shade, c. 5 m elevation. UKMB.

PL 287: Bumbun Besar Island. On rock, exposed, c. 3 m elevation. UKMB.

PL 154: Tanjung Rhu. On limestone, exposed, c. 50 m elevation. UKMB.

*Pyrrosia varia* (Kaulf.) Fawcett, Am. Midl. Nat. 12: 302. 1931.

PL 255: Tanjung Dagu Forest Reserve; track to Tanjung Apau. On rock, in light shade, c. 140 m elevation. UKMB.

*Pyrrosia penangiana* (Hook.) Holtt., Fl. Malaya II. 146–147, pl. 62. 1968.

Tanjung Rhu. On limestone by the sea. In light shade, c. 8 m elevation. Slight record, not collected.

*Pyrrosia longifolia* (Burm.) Morton, Wash. Acad. Sci. 36: 168: 1946.

PL 85: Kisap; Boon Siew Estate. Epiphyte, in light shade, c. 30 m elevation. UKMB, duplicate at K.

*Pyrrosia stigmosa* (Sw.) Ching, Bull. Chin. Bot. Soc. 1: 67. 1935.

PL 234: Dayang Bunting Island. On rock, exposed. c. 5 m elevation. UKMB.

*Drymoglossum piloselloides* (Linn.) Presl, Tent. Pterid. 227. 1836.

Duit-duit; sisik naga; sakat ribu-ribu.

PL 109: Kampong Belanga Pecah. Epiphyte, in light shade, c. 30 m elevation. UKMB.

PL 237: Kisap; Boon Siew Estate. Epiphyte, in light shade, c. 30 m elevation. UKMB.

*Belvisia mucronata* (Fée) Copel., Gen. Fil. 192. 1947.

PL 77: Near summit of Gunung Raya. Epiphyte, in light shade, c. 850 m elevation. UKMB, duplicate at K.

*Loxogramme avenia* (Bl.) Presl, Tent. Pterid. 215. 1836.

PL 267: Gunung Raya Forest Reserve; Genting Palas. On mossy rock, in light shade, c. 450 m elevation. UKMB, duplicate at K.

*Microsorium punctatum* (Linn.) Copel, Univ. Cal. Publ. Bot. 16: 111. 1929.

PL 5: Bukit Malut Forest Reserve. Epiphyte on *Pandanus*, in light shade, c. 30 m elevation. UKMB.

PL 177: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade; c. 30 m elevation. UKMB, duplicate at K.

*PL 190*: Kisap; Kuala Kisap. Epiphyte on *Hydrocarpus*, in light shade, c. 5 m elevation. UKMB.

*PL 245*: Gunung Raya Forest Reserve; Lubuk Semilang. Epiphyte, in light shade, c. 100 m elevation. UKMB, duplicate at K.

*PL 235*: Dayang Bunting Island, foot of Gua Langsir. On rock, in light shade, c. 10 m elevation. UKMB.

*Microsorium heterocarpum* (Bl.) Ching, Bull. Fan. Mem. Inst. 4: 295. 1933.

*PL 275*: Gunung Raya Forest Reserve; Genting Palas. On rock, in deep shade, c. 50 m elevation. UKMB.

*Colysis acuminata* (Bak.) Holtt., Fl. Malaya II. 162–163. 1968. var. *angustata* Holtt.

*PL 161*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in stream bed, in deep shade, c. 50 m elevation. UKMB.

*PL 199*: Gunung Raya Forest Reserve; Genting Palas. On rock, in stream bed, in deep shade, c. 800 m elevation. UKMB, duplicate at K.

*PL 240*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 90 m elevation. UKMB.

*Colysis pedunculata* (Hook. et. Grev.) Ching, Bull. Fan. Mem. Inst. 4: 321. 1933.

*PL 15*: Bukit Malut Forest Reserve. Epiphyte, in deep shade, c. 130 m elevation. UKMB.

*Drynaria sparsisora* (Desv.) Moore, Ind. Fil. 348. 1862.

*PL 36*: Bukit Malut Forest Reserve. Epiphyte, exposed, c. 5 m elevation. UKMB.

*PL 167*: Kampung Sungai Taru; Klebang-Lubuk Semilang Road. Epiphyte, exposed, c. 40 m elevation. UKMB.

*PL 196*: Lentang Jalan Island. On rock, exposed, c. 4 m elevation. UKMB.

*PL 178*: Kisap. Epiphyte, in light shade, c. 30 m elevation. UKMB.

*PL 246*: Gunung Raya Forest Reserve; Lubuk Semilang. Epiphyte, in light shade, c. 100 m elevation. UKMB, duplicate at K.

*Drynaria rigidula* (Sw.) Beddome, Ferns Brit. Ind. t.314. 1869.

*PL 84*: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade, c. 30 m elevation. UKMB, duplicate at K.

*PL 179*: Kisap; Boon Siew Estate. Epiphyte on *Hevea brasiliensis*, in light shade, c. 30 m elevation. UKMB, duplicate at K.

*Drynaria bonii* Chr., Not. Syst. 1: 186. 1910.

*PL 205*: Langgun Island. On rock, exposed, c. 20 m elevation. Rare. UKMB, duplicate at K. Also collected by Chin (1977). KLU.

*Pseudodrynaria coronans* (Wall.) Ching, Sunyatsenia 5, 4: 262. 1940.

*PL 58*: Gunung Raya Forest Reserve. Epiphyte, in light shade, c. 750 m elevation. UKMB, 2 sheets.

*PL 212*: Near summit of Gunung Raya. Epiphyte, in light shade, c. 800 m elevation. Rare. UKMB.

*Phymatodes nigrescens* (Bl.) J. Smith, Ferns Br. & For. 94. 1966.

Paku sumpah; paku ciai.

*PL 102*: Gunung Raya Forest Reserve; Durian Perangin Waterfall. On rock, exposed, c. 130 m elevation. UKMB.

*PL 244*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 100 m elevation. UKMB, duplicate at K.

*Phymatodes scolopendria* (Burm.) Ching, Contr. Inst. Bot. Nat. Acad. Peiping 2: 63, 1933.

*PL 168*: Machinchang Forest Reserve; Tanjung Datai. Terrestrial, exposed, c. 5 m elevation. UKMB.

*Crypsinus trilobus* (Houtt.) Copel., Gen. Fil. 206. 1947.

*PL 74*: Summit of Gunung Raya. Epiphyte, in light shade. UKMB.

*Lecanopteris sinuosa* Copel., Univ. Calif. Publ. Bot. 16: 123. 1929.

*PL 110*: Kampong Belanga Pecah. Epiphyte by roadside, exposed, c. 30 m elevation. UKMB, duplicate at K.

*Goniophlebium persicifolium* Bedd. 1870 (not in Handb.)

*PL 71*: Near summit of Gunung Raya, Epiphyte, in light shade, associated with *Vittaria* and *Drynaria*, c. 900 m elevation. UKMB, duplicate at K.

*PL 213*: Summit of Gunung Raya. Epiphyte, in light shade, c. 960 m elevation. UKMB, duplicate at K.

#### THELYPTERIDACEAE

*Mesophlebium chlamydophorum* (C. Chr.) Holttum, Blumea 22: 321: 1975; Holttum 1981a: 384.

*PL 280*: Gunung Raya Forest Reserve; Genting Palas. Terrestrial, on stream bank, in light shade, c. 550 m elevation. UKMB.

*Cyclosorus interruptus* (Willd.) H. Ito, Bot. Mag. Tokyo 51: 714: 1937; Holttum 1981a: 386.

*PL 256*: Selat Panchor Forest Reserve; track to Tanjung Apau. Terrestrial, in light shade, c. 160 m elevation. UKMB.

*Sphaerostephanos heterocarpus* (Bl.) Holttum in Nayar & Kaur, Compl. to Beddome: 280. 1974; Holttum 1981a: 457.

*PL 286*: Guan Thong Estate. Terrestrial, exposed, c. 20 m elevation. UKMB, duplicate at K.

*Sphaerostephanos penniger* (Hook.) Holttum in Nayar. & Kaur, Compl. to Beddome: 209. 1974; Holttum 1981a: 461.

*PL 53*: Gunung Raya Forest Reserve. Terrestrial, in light shade, c. 650 m elevation. UKMB, duplicate at K.

*RJ 2101 Razali Jaman*: Guan Thong Estate. Terrestrial, in light shade, c. 40 m elevation. UKMB.

*Pronephrium asperum* (Presl.) Holttum, Blumea 20: 112. 1972; Holttum 1981a: 512.

*PL 50*: Gunung Raya Forest Reserve. Terrestrial, near track to summit, in light shade, c. 650 m elevation. UKMB.

*PL 2*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 120 m elevation. UKMB.

*PL 101*: Gunung Raya Forest Reserve; Durian Perangin Waterfall. Terrestrial, in light shade, c. 50 m elevation. UKMB.

*PL 129*: Track to Seven Wells. Terrestrial, in light shade, c. 90 m elevation. UKMB, duplicate at K.

*Pronephrium repandum* (Fée) Holttum, *Blumea* 20: 109. 1972; Holttum 1981a: 533.

*PL 136*: Seven Wells. Terrestrial, on slope, in light shade, c. 200 m elevation. UKMB, duplicate at K.

*PL 262*: Gunung Raya Forest Reserve: Sungai Kelian. Terrestrial, in light shade, c. 150 m elevation. UKMB, duplicate at K.

*Christella papilio* (Hope) Holttum in Nayar & Kaur, *Compl. to Beddome*, 208. 1974; Holttum 1981a: 556.

*PL 69*: Gunung Raya Forest Reserve. Terrestrial, in light shade, c. 600 m elevation. UKMB, duplicate at K.

*Christella subpubescens* (Bl.) Holttum, *Webbia* 30: 193. 1976; Holttum 1981a: 558.

*PL 200*: Gunung Raya Forest Reserve: Genting Palas. Terrestrial, on humus-rich stream bank, in deep shade, c. 800 m elevation. UKMB, duplicate at K.

*Christella parasitica* (L.) Lev., *Fl. de Kouy-teheou*: 475. 1915; Holttum 1981a: 559.

*PL 38*: Guan Thong Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB, duplicate at K.

*PL 10*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 100 m elevation. UKMB.

*PL 33*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 55 m elevation. UKMB, duplicate at K.

*PL 143*: Machinchang Forest Reserve. Terrestrial, in light shade, c. 90 m elevation. UKMB.

*Christella dentata* (Forsk.) Brownsey & Jermy, *Brit. Fern Gaz.* 10: 338. 1973; Holttum 1981a: 557.

*PL 17*: Bukit Malut Forest Reserve. Terrestrial, on slope, in light shade, c. 450 m elevation. UKMB, duplicate at K.

*PL 160*: Gunung Raya Forest Reserve; Lubuk Semilang. Terrestrial, in light shade, c. 45 m elevation. UKMB.

*Amphineuron terminans* (Hook.) Holttum, *Amer. Fern.* 63: 82. 1973; Holttum 1981a: 545.

*PL 18*: Bukit Malut Forest Reserve. Terrestrial, on slope, in light shade, c. 450 m elevation. UKMB, duplicate at K.

*PL 119*: Dayang Bunting Island, track to the lake. Terrestrial, in light shade, c. 5 m elevation. UKMB, duplicate at K.

*PL 236*: Kisap; Boon Siew Estate. Terrestrial, exposed, c. 40 m elevation. UKMB.

*Amphineuron opulentum* (Kaulf.) Holttum, *Blumea* 19: 45. 1971; Holttum 1981a: 548.

*PL 27*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 30 m elevation. UKMB, duplicate at K.

*PL 151*: Gunung Raya Forest Reserve; Kampong Batu Asah. Terrestrial, in light shade, c. 30 m elevation. UKMB.

*Amphineuron immersum* (Bl.) Holttum, in Nayar & Kaur, *Compl. to Beddome*: 203. 1974; Holttum 1981a: 547.

PL 22: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 120 m elevation. UKMB.

PL 52: Near summit of Gunung Raya. Terrestrial, in deep shade, c. 950 m elevation. UKMB, duplicate at K.

## DENNSTAEDTIACEAE

### Dennstaedtioideae

*Microlepia strigosa* (Thb.) Pr., Epimel. Bot. 95. 1849.

PL 61: Near summit of Gunung Raya. Terrestrial, in light shade, c. 900 m elevation. UKMB, duplicate at K.

PL 215: Summit of Gunung Raya. Terrestrial, in deep shade, c. 950 m elevation. UKMB, duplicate at K.

*Microlepia speluncae* (L.) Index XCIII. 1857. var. *hancei*.

PL 8: Bukit Malut Forest Reserve. Terrestrial, exposed, c. 100 m elevation. UKMB, duplicate at K.

PL 87: Kisap; Boon Siew Estate. Terrestrial, on stream bank, in light shade, c. 40 m elevation. UKMB, duplicate at K.

*Microlepia speluncae* (L.) Moore, Index XCIII. 1857 var. *villosissima* C. Chr. Gard. Bull. Str. Settl. 4: 399 (1929).

PL 31: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 60 m elevation. UKMB.

PL 144: Machinchang Forest Reserve. Terrestrial, exposed, c. 90 m elevation. UKMB.

### Lindsaeoideae

*Lindsaea repens* (Bory) Thwaites, En. Pl. Zeyl.: 388. 1864; Kramer 1971: 237.

H.C. Robinson. Langkawi. November 1916. K.

PL 158: Gunung Raya Forest Reserve; Lubuk Semilang. On rock near stream bank, in deep shade, c. 40 m elevation. UKMB.

PL 278: Gunung Raya Forest Reserve; Genting Palas. Climbing in deep shade, c. 520 m elevation. UKMB.

*Lindsaea repens* (Bory) Thwaites var. *pectinata* (Blume) Meet. ex Kuhn; Kramer 1971: 239.

PL 278: Gunung Raya Forest Reserve; Genting Palas. Epiphyte, in deep shade, c. 520 m elevation. UKMB.

*Lindsaea lucida* Bl., Enum. Pl. Jav. 216. 1828; Kramer 1971: 233.

PL 277: Gunung Raya Forest Reserve; Genting Palas. On rock near stream bank, in deep shade, c. 520 m elevation. UKMB.

*Lindsaea ensifolia* Sw. Schrad. Journ. 1800/2: 77. 1801; Kramer 1971: 211.

PL 89: Kampong Batu Asah. Terrestrial, in light shade, c. 35 m elevation. UKMB.

PL 132: Seven Wells. On rock, in light shade, c. 200 m elevation. UKMB.

*Lindsaea heterophylla* Dryand., Trans. Linn. Cos. 3: 41. pl. 8. f. 1. 1791; Kramer 1971: 210.

*PL 20*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 200 m elevation. UKMB.

*PL 141*: Machinchang Forest Reserve. Terrestrial, in light shade, c. 200 m elevation. UKMB.

*PL 187*: Kisap; Kuala Kisap. Terrestrial, in light shade, c. 30 m elevation. UKMB.

*Lindsaea parasitica* (Roxburgh ex Griffith) Hieron, *Hedwigia*: 62. 14. 1920; Kramer 1971: 244.

*PL 204*: Near summit of Gunung Raya. Epiphyte, in light shade, c. 900 m elevation. UKMB, duplicate at K.

*Tapeinidium pinnatum* (Cav.) C.Ch., Ind. Fil. 213. 1905; Kramer 1971: 191.

*PL 210*: Near summit of Gunung Raya. Terrestrial, in light shade, c. 950 m elevation. UKMB.

### Davallioideae

*Davallia denticulata* (Burm.) Mett., Kuhn, Fil. Dec. 27. 1867.

Paku tertutup.

*PL 73*: Gunung Raya Forest Reserve. Epiphyte, in light shade, c. 650 m elevation. UKMB.

*PL 156*: Bukit Sawak Forest Reserve. Epiphyte, in light shade, c. 150 m elevation. UKMB.

*PL 174*: Padang Lalang. Epiphyte, exposed, c. 5 m elevation. UKMB, duplicate at K.

*PL 197*: Lentang Jalan Island. On rock, in light shade, c. 6 m elevation. UKMB, duplicate at K.

*PL 232*: Dayang Bunting Island. On rock, by the beach, exposed. UKMB, duplicate at K.

*Davallia trichomanoides* Bl., Enum. Pl. Jav. 238. 1828.

*PL 285*: Track to summit of Gunung Raya. Epiphyte, in deep shade, c. 600 m elevation. UKMB.

*Davallia trichomanoides* Bl. var *lorrainii* (Hance) Holtt.

*PL 216*: Summit of Gunung Raya. Epiphyte, in deep shade, c. 960 m elevation. UKMB, duplicate at K.

*Davallia divaricata* Bl., Enum. Pl. Jav. 237. 1828.

*PL 54*: Gunung Raya Forest Reserve. Epiphyte, in light shade, c. 660 m elevation. UKMB, duplicate at K.

*Humata pectinata* (Sm.) Desv., Prodr. 323. 1827.

Tanjung Rhu. On limestone cliff by the beach, in light shade, c. 8 m elevation. Sight record.

*Humata vestita* (Bl.) Moore, Index XCIII. 1857.

*PL 131*: Seven Wells. On rock in light shade, c. 200 m elevation. UKMB, duplicate at K.

*Humata repens* (L.f.) Diels, Nat. Pflanzenfam. 1/4: 209. 1899.

*PL 75*: Track to summit of Gunung Raya. Epiphyte, in deep shade, c. 900 m elevation. UKMB.

**Oleandroideae**

*Nephrolepis biserrata* (Sw.) Schott, Gen. Fil. ad t. 3. 1834.

PL 116: Kedawang; Kampong Lubuk Buaya. Terrestrial, exposed, c. 5 m elevation. UKMB.

PL 120: Singa Besar Island. Terrestrial, exposed, c. 5 m elevation. UKMB.

*Nephrolepis biserrata* (Sw.) Schott var. *exaltata*.

Kuah. Ornamental plant. Sight record.

*Nephrolepis hirsutula* (Forst.) Pr., Tent. Pterid. 79. 1836.

PL 184: Kisap; Kuala Kisap. Terrestrial, exposed, c. 30 m elevation. UKMB.

*Oleandra pistillaris* (Sw.) C. Chr., Ind. Fil., Suppl. III: 132. 1834.

PL 214: Near summit of Gunung Raya. Terrestrial, in light shade, c. 950 m elevation. UKMB.

**Pteridioideae**

*Pteris vittata* Linn., Spec. Pl. 2: 1074. 1753.

PL 83: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 30 m elevation. UKMB.

PL 153: Kisap. Terrestrial, in light shade, c. 40 m elevation. UKMB.

*Pteris ensiformis* Burm., Fl. Ind. 230. 1768.

Mukut; paku lemukut.

PL 47: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB.

PL 107: Gunung Raya Forest Reserve; Durian Perangin Waterfall. Terrestrial, in light shade, c. 100 m elevation. UKMB.

PL 258: Selat Panchor Forest Reserve; track to Tanjung Apau. Terrestrial, in light shade, c. 110 m elevation. UKMB.

*Pteris scabripes* Wall. apud. Hook., Spec. Fil. 2: 165. 1858.

No. 3381. C. Curtis. Foot of Gunung Raya. Terrestrial, April 1896. K.

No. 15789. M.R. Henderson. Teluk Barau. Terrestrial. April 1911. K.

PL 219: Bukit Sawak Forest Reserve. Terrestrial, in light shade, c. 80 m elevation. UKMB.

PL 260: Gunung Raya Forest Reserve: Sungai Kelian. Terrestrial, exposed, c. 55 m elevation. UKMB.

*Pteris venulosa* Bl., Enum. Pl. Jav. 209. 1828.

PL 127: Seven Wells. Terrestrial, in deep shade, c. 90 m elevation. UKMB, duplicate at K.

*Pteris biaurita* Linn., Spec. Pl. 2: 1076. 1753.

No. 6361: H.C. Robinson. Terutau. November 1916. K.

No. 29178: R.E. Holttum. Kisap. 30 November 1931. K.

PL 41: Guan Thong Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB.

PL 88: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 40 m elevation. UKMB, duplicate at K.

*PL 142*: Machinchang Forest Reserve. Terrestrial, in light shade, c. 90 m elevation. UKMB, duplicate at K.

*Pteris mertensioides* Willd., Sp. Pl. 5:394. 1810.

*PL 23*: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 120 m elevation. UKMB.

*Pteris longipinnula* Wall., Cat. No. 108 (nom. nud.); Agardh, Recen. Pterid. 19. 1839.

*PL 48*: Gunung Raya Forest Reserve. Terrestrial, exposed, c. 500 m elevation. UKMB, duplicate at K.

*Acrostichum aureum* Linn., Spec. Pl. 2: 1069. 73. 1753.

Larat; piai lasa; piai raja.

*PL 112*: Kuala Temoyong. In mangrove swamp, c. 0 m elevation. UKMB, duplicate at K.

*Acrostichum speciosum* Willd., Spec. Pl. 5: 117. 1810.

*PL 111*: Kuala Temoyong. In mangrove swamp, by the beach. UKMB, duplicate at K.

*PL 121*: Singa Besar Island. In mangrove swamp, by the beach. UKMB.

*Stenochlaena palustris* (Burm.) Bedd., Ferns Brit. Ind. Suppl. 26. 1876.

*PL 14*: Bukit Malut Forest Reserve. Climbing, in light shade, c. 100 m elevation. UKMB.

### Asplenioidae

*Asplenium nidus* Linn., Spec. Pl. 2: 1079. 1753.

Daun semum; paku langsuyar.

*PL 108*: Gunung Raya Forest Reserve; Durian Perangin Waterfall. Epiphyte, in light shade, c. 140 m elevation. UKMB.

*Asplenium phyllitidis* Don, Prodr. Fl. Nep. 7. 1825.

*PL 13*: Bukit Malut Forest Reserve. Epiphyte, in light shade, c. 100 m elevation. UKMB.

*PL 163*: Gunung Raya Forest Reserve; Lubuk Semilang. Epiphyte on *Knema laurina*, in light shade, c. 50 m elevation. UKMB.

*PL 173*: Machinchang Forest Reserve; Teluk Datai. Epiphyte, in light shade, c. 5 m elevation. UKMB.

*Asplenium phyllitidis* Don subsp. *malesicum* Holttum; Gard. Bull. Sing. 27: 153. 1974.

*PL 70*: Near summit of Gunung Raya. Epiphyte, in light shade, c. 870 m elevation. UKMB, duplicate at K.

*Asplenium salignum* Bl., Enum. Pl. Jav. 175. 1828.

*PL 266*: Gunung Raya Forest Reserve; Genting Palas. On rock, in deep shade, c. 450 m elevation. UKMB, duplicate at K.

*PL 270*: Gunung Raja Forest Reserve; Genting Palas. On rock, in deep shade, c. 450 m elevation. UKMB, duplicate at K.

*Asplenium spathulinum* J. Smith, J. Bot. 3: 408. 1813.

*PL 55*: Gunung Raya Forest Reserve. Epiphyte, in deep shade, c. 720 m elevation. UKMB.

*PL 57*: Near track to summit of Gunung Raya. Epiphyte, in deep shade, c. 750 m elevation. UKMB.

*PL 254*: Tanjung Dagu Forest Reserve. Epiphyte, associated with *A. nidus*, in deep shade, c. 90 m elevation. UKMB, duplicate at K.

*Asplenium pellucidum* Lam., Encyl. 2: 305. 1786.

*PL 241*: Gunung Raya Forest Reserve; Lubuk Semilang. Epiphyte, in deep shade, c. 95 m elevation. UKMB, duplicate at K.

*Asplenium macrophyllum* Sw., Schrad. Journ. 1800/2: 52. 1801.

*PL 182*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 500 m elevation. UKMB.

*PL 233*: Dayang Bunting Island. On rock, in light shade, c. 2 m elevation. UKMB.

*PL 247*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 190 m elevation. UKMB. 2 sheets.

*PL 269*: Gunung Raja Forest Reserve; Genting Palas. On rock, in deep shade, c. 450 m elevation. UKMB, duplicate at K.

*Asplenium tenerum* Forster, Prodr. 80, 1786.

*PL 68*: Near summit of Gunung Raya. Epiphyte, in deep shade, c. 900 m elevation. UKMB, duplicate at K.

*Asplenium paradoxum* Bl., Enum. Pl. Jav. 179. 1828.

No. 15486. H.N. Ridley. Gunung Raya. February 1911. K.

### Blechnoideae

*Blechnum orientale* Linn., Spec. Pl. 2: 1077. 1753.

Paku ikan.

*PL 7*: Bukit Malut Forest Reserve. Terrestrial, on exposed earth bank, c. 100 m elevation. UKMB, duplicate at K.

### Lomariopsidoideae

*Lomariopsis lineata* (Presl.) Holttum Novit. Bot. Inst. Prag. 1968 (1969) 9; Holttum 1978: 262.

*PL 159*: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in deep shade, c. 40 m elevation. UKMB.

*Elaphoglossum callifolium* (Bl.) Moore, Ind. Fil. (1857) 7.

*PL 76*: Near summit of Gunung Raya. Epiphyte, in deep shade, c. 900 m elevation. UKMB.

*Bolbitis heteroclita* (Pr.) Ching, in C. Chr., Ind. Fil. Suppl. III, 48. 1934.

*PL 250*: Selat Panchor Forest Reserve. Terrestrial, in deep shade, c. 50 m elevation. UKMB, duplicate at K.

*PL 51*: Gunung Raya Forest Reserve, near track to summit. Climbing, in deep shade, c. 600 m elevation. UKMB.

*PL 66*: Gunung Raya Forest Reserve, near track to summit. Terrestrial, in deep shade, c. 650 m elevation. UKMB.

*PL 251*: Selat Panchor Forest Reserve, track to Tanjung Apau. Climbing in deep shade, c. 50 m elevation. UKMB.

PL 265: Gunung Raya Forest Reserve; Sungai Kelian. On rock, in deep shade, c. 50 m elevation. UKMB.

PL 272: Gunung Raya Forest Reserve; Genting Palas. On rock, in deep shade, c. 460 m elevation. UKMB.

*Bolbitis malaccensis* (C.Chr.) Ching, in C. Chr., Ind. Fil. Suppl. III, 49. 1934. Langkawi. R.E. Holttum (1968). Rare.

*Bolbitis appendiculata* (Willd.) Iwatsuki, Acta Phytotax. Geobot. 18: 48. 1959. (*Egenolfia appendiculata* in Holttum 1968: 459.).

PL 12: Bukit Malut Forest Reserve. On rock, in light shade, c. 100 m elevation. UKMB.

PL 95: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 50 m elevation. UKMB.

PL 118: Dayang Bunting Island. Terrestrial, by trackside to the lake, in light shade, c. 5 m elevation. UKMB.

PL 130: Path to Seven Wells. On rock, in light shade, c. 110 m elevation. UKMB.

PL 140: Machinchang Forest Reserve. On rock, in deep shade, c. 60 m elevation. UKMB, duplicate at K.

*Bolbitis virens* (Wall.) Schott, Gen. Fil. at t. 14. 1834.

PL 220: Bukit Sawak Forest Reserve. On rock, in deep shade, 0.50 m elevation. UKMB.

PL 276: Gunung Raya Forest Reserve; Genting Palas. Terrestrial, in deep shade, c. 500 m elevation. UKMB. 2 sheets.

### Dryopteridoideae

*Polystichum prolificans* V.A.V.R., Bull. Jard. Bot. Buitenz., III ser., 2: 170. 1920.

PL 72: Near summit of Gunung Raya. Terrestrial, in deep shade, c. 900 m elevation. UKMB, duplicate at K.

### Tectarioideae

*Tectaria brachiata* (Zoll. & Mor.) Morton, Contr. U.S. Nat. Herb. 38. 217. 1973; Holttum 1981b: 137, excl. *Aspidium variolosum* and its synonyms.

PL 24: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 120 m elevation. UKMB.

PL 34: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 10 m elevation. UKMB, duplicate at K.

PL 45: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB, duplicate at K.

PL 97: Ulu Melaka; Kampong Bukit Hantu. Terrestrial, in light shade, c. 60 m elevation. UKMB, duplicate at K.

*Tectaria variolosa* (Hook.) C. Chr., Contr. U.S. Nat. Herb. 26 (1931) 289.

PL 222: Timun Island, Tanjung Timun. In rock crevices, exposed to sunlight and sea-sprays, c. 6 m elevation. UKMB, duplicate at K. Rare.

*Tectaria semipinnata* (Roxb.) Morton, Contr. U.S. Nat. Herb. 38 (1974) 286. (*T. maingayi* in Holttum 1981b: 513).

PL 49: Gunung Raya Forest Reserve. Terrestrial, in light shade, c. 650 m elevation. UKMB, duplicate at K.

*PL 100*: Gunung Raya Forest Reserve; Durian Perangin Waterfall. Terrestrial, in light shade, c. 50 m elevation. UKMB, duplicate at K.

*Tectaria angulata* (Willd.) Copel., Sarawak Mus. J. 2: 370. 1917.

*PL 164*: Gunung Raya Forest Reserve; Lubuk Semilang, near pumphouse. Terrestrial, in light shade, c. 40 m elevation. UKMB.

*PL 123*: Singa Besar Island. Terrestrial, in light shade, c. 7 m elevation. UKMB.

*Tectaria rumicifolia* (Ridley) C. Chr. in Holttum 1968: 519, 636; *T. oligophylla* (Rosenst.) C. Chr.

*PL 137*: Machinchang Forest Reserve. Terrestrial, on slope, in deep shade, c. 240 m elevation. UKMB, duplicate at K.

*Cyclopeltis crenata* (Fée) C. Chr., Ind. Fil. Suppl. 64. 1934.

*PL 253*: Tanjung Dagu Forest Reserve; track to Tanjung Apau. Terrestrial, in deep shade, c. 60 m elevation. UKMB, duplicate at K.

*Arcypteris irregularis* (Pr.) Holtt., Reinwardtia 1: 193. 1951.

*PL 82*: Kisap; Boon Siew Estate, track to Gunung Raya. Terrestrial, in light shade, c. 30 m elevation. UKMB, duplicate at K.

*Ctenitis mannii* (Hope) Ching, Bull. Fan. Mem. Inst. Bot. 8: 289. 1938.

*PL 201*: Gunung Raya Forest Reserve; Genting Palas. On rock, in light shade, c. 800 m elevation. UKMB, duplicate at K.

*Ctenitis subobscura* (Christ) Holttum, Fern Gaz. 12: 320 (1934); Blumea 31: 23 (1985).

No. 15548. *Md. Haniff*. Gunung Raya. 1911. K.

### Athyrioideae

*Diplazium esculentum* (Retz) Sw., Schrad. J. Bot. 1801/2: 312. 1803; Holttum 1968, App. II: 637.

Paku besar.

*PL 125*: Kuah; Kampong Padang Lalung. Terrestrial, in swamp, exposed, c. 50 m elevation. UKMB.

*Diplazium malaccense* Pr., Epim. Bot. 86. 1849; Holttum 1968, App. II: 637.

*PL 207*: Near summit of Gunung Raya. Terrestrial, in light shade, c. 950 m elevation. UKMB, duplicate at K.

*Diplazium bantamense* Bl., Enum. Pl. Jav. 191. 1828; Holttum 1968, App. II: 637.

*PL 60*: Track to summit of Gunung Raya. Terrestrial, in deep shade, c. 900 m elevation. UKMB.

### ADIANTACEAE

*Ceratopteris thalictroides* (Linn.) Brongn., Bull. Soc. Philon. 1821: 86.

Paku dodok.

*PL 14*: Kampong Kubang Badak. In rice-field, c. 5 m elevation. UKMB.

*PL 90*: Kampong Batu Asah. On stream-bed, in light shade, c. 30 m elevation. UKMB.

*PL 114*: Kampong Lubuk Buaya. In mud, exposed, c. 5 m elevation. UKMB, duplicate at K.

- PL 147: Kampong Kubang Badak. In rice-field, c. 5 m elevation. UKMB.
- PL 224: Kisap; Boon Siew Estate. In mud, exposed, c. 30 m elevation. UKMB.
- Taenitis blechnoides* (Willd.) Sw., Syn. Fil. 24, 220. 1806.  
Paku bulu.
- PL 3: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 100 m elevation. UKMB.
- PL 4: Bukit Malut Forest Reserve. Terrestrial, in light shade, c. 100 m elevation. UKMB.
- PL 135: Seven Wells. Terrestrial, on stream bank, in light shade, c. 200 m elevation. UKMB.
- PL 261: Gunung Raya Forest Reserve; Genting Palas. Terrestrial, in light shade, c. 100 m elevation. UKMB.
- PL 283: Gunung Raya Forest Reserve; Genting Palas. Terrestrial, in light shade, c. 550 m elevation. UKMB.
- No. 15786: M.R. Henderson. Teluk Barau. April 1911. K.
- Cheilanthes tenuifolia* (Burm.) Sw., Syn. Fil. 129, 332. 1806.  
Resam padi; temangah; telur belangkas.
- No. 2039: Abdul Samat Abdullah. Kuah. KLU, duplicate at K.
- PL 43: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB, duplicate at K.
- PL 138: Kampong Kubang Badak. Terrestrial, exposed, c. 40 m elevation. UKMB.
- Pityrogramma calomelanos* (L.) Link, Handb. Gew: 3:20. 1833.  
Paku hijau.
- PL 9: Bukit Malut Forest Reserve. Terrestrial, exposed, c. 100 m elevation. UKMB.
- Doryopteris ludens* (Wall.) J. Sm., Hist. Fil. 289. 1875.  
H.C. Robinson. Dayang Bunting Island. November 1916. K.
- No. 29066: M.R. Henderson. Selat Panchor, c. 50 m elevation. November 1934. K.
- PL 46: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB.
- PL 221: Timun Island. In rock crevices, c. 1 m elevation. UKMB.
- Hemionitis arifolia* (Burm.) Moore, Ind. Fil. 114. 1859.  
PL 32: Bukit Sawak Forest Reserve. On rock, in light shade, c. 50 m elevation. UKMB.
- PL 46: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB, duplicate at K.
- PL 225: Kisap; Boon Siew Estate, near Kedah Marble Factory. Terrestrial, in light shade, c. 30 m elevation. UKMB.
- Adiantum stenochylamys* Bak., Am. Bot. 5: 29. 1891.  
No. 15788: M.R. Henderson. Teluk Barau. April 1911. K.
- Timun Island. On rock, exposed, c. 6 m elevation. Not collected. Sight record.
- Adiantum caudatum* Linn., Mantissa 308. 1771.  
PL 230: Dayang Bunting Island. Terrestrial, in light shade, c. 10 m elevation. UKMB, duplicate at K.

*Adiantum philippense* Linn., Spec. Pl. 2: 1094. 1753.

Paku sisik; paku mega.

No. 29074. M.R. Henderson. Selat Panchor, c. 100 m elevation. 23 November 1934. K.

PL 44: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 70 m elevation. UKMB; duplicate at K.

PL 229: Timun Island; Tanjung Timun. In rock crevices, exposed, c. 6 m elevation. UKMB, duplicate at K.

PL 231: Dayang Bunting Island. Terrestrial, in light shade, c. 10 m elevation. UKMB, duplicate at K.

*Adiantum capillus-veneris* Linn., Spec. Pl. 2: 1096. 1753.

Kuah. Ornamental plant. Sight record.

*Adiantum mathewsianum* Hook., Sp. Fil. 2: 35. 1858.

Kuah. Ornamental plant. Sight record.

*Adiantum peruvianum* Kl., Linnaea 18: 555. 1845.

Kuah. Ornamental plant. Sight record.

*Adiantum trapeziforme* Linn., Spec. Pl. 2: 1097. 1753.

Kuah. Ornamental plant. Sight record.

*Adiantum tenerum* Swartz., Prodrum 135. 1788.

Kuah. Ornamental plant. Sight record.

*Adiantum latifolium* Lam, Encycl. 1: 43. 1783.

PL 42: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 20 m elevation. UKMB.

PL 81: Kisap; Boon Siew Estate. Terrestrial, in light shade, c. 30 m elevation. UKMB.

*Adiantum polyphyllum* Willd., Sp. Pl. 5: 454. 1828.

Kuah. Ornamental plant. Sight record.

*Antrophyum callifolium* Bl., Enum. Pl. Jav. III. 1828.

No. 6359. H.C. Robinson. Terutau. April 1911. K.

PL 16: Bukit Malut Forest Reserve. On rock, in light shade, c. 500 m elevation. UKMB, duplicate at K.

PL 103: Gunung Raya Forest Reserve; Durian Perangin Waterfall. On rock, in deep shade, c. 100 m elevation. UKMB.

PL 242: Gunung Raya Forest Reserve; Lubuk Semilang. On rock, in light shade, c. 100 m elevation. UKMB, duplicate at K.

PL 274: Gunung Raya Forest Reserve; Genting Palas. On rock, in deep shade, c. 500 m elevation, UKMB.

*Vittaria ensiformis* Sw., Ges. Nat. Fr. Berl. Neu. Schr. 2: 134, t. 7. f. 1. 1799.

No. 15831. H.C. Robinson. Pulau Adang: April 1911. K.

PL 106: Gunung Raya Forest Reserve; Durian Perangin Waterfall. Epiphyte, exposed, c. 100 m elevation. UKMB, duplicate at K.

PL 139: Machinchang Forest Reserve. Epiphyte on *Pentacalyx*, in light shade, c. 50 m elevation. UKMB.

PL 172: Machinchang Forest Reserve; Teluk Datai. Epiphyte, in light shade, c. 5 m elevation. UKMB, duplicate at K.

*Vittaria ensiformis* Sw. var. *latifolia* Holttum.

PL 56: Gunung Raya Forest Reserve. Epiphyte, in light shade, c. 720 m elevation. UKMB. 2 sheets.

PL 193: Bumbun Besar Island. On rock, exposed, c. 3 m elevation. UKMB.

*Vittaria angustifolia* Bl., Enum. Pl. Jav. 199. 1828.

PL 249: Gunung Raya Forest Reserve; Lubuk Semilang. Epiphyte, in light shade, c. 90 m elevation. UKMB.

### MARSILEACEAE

*Marsilea crenata* Presl, Rel-Haenk. 1: 84, t. 12, f. 13. 1825.

PL 98: Hulu Melaka; Kampong Bukit Hantu. In rice-field, exposed, c. 50 m elevation. UKMB, duplicate at K.

PL 99: Hulu Melaka; Kampong Bukit Hantu. In rice-field, exposed, c. 50 m elevation. UKMB, duplicate at K.

PL 146: Kampong Kubang Badak. In rice-field, exposed, c. 5 m elevation. UKMB.

### AZOLLACEAE

*Azolla pinnata* R. Br., Prodr. Fl. N. Holl. 167. 1810.

Hulu Melaka; Kampong Bukit Hantu. In rice-field, exposed, c. 5 m elevation. Sight record.

The breakdown of the fern flora is as shown in Table 1 below:

Table 1  
Breakdown of the Langkawian Fern Flora.

Families/Subfamilies	Genera	No. of species (incl. subspecies, varieties and hybrids)
OPHIOGLOSSACEAE	<i>Helminthostachys</i>	1
MARATTIACEAE	<i>Angiopteris</i>	1
SCHIZAEACEAE	<i>Schizaea</i>	2
	<i>Lygodium</i>	6
GLEICHENIACEAE	<i>Dicranopteris</i>	2
HYMENOPHYLLACEAE	<i>Hymenophyllum</i>	1
	<i>Trichomanes</i>	8
	<i>Cyathea</i>	3
CYATHEACEAE	<i>Platyserium</i>	4
POLYPODIACEAE	<i>Pyrrosia</i>	5
	<i>Drymoglossum</i>	1
	<i>Belvisia</i>	1
	<i>Loxogramme</i>	1
	<i>Microsorium</i>	2
	<i>Colysis</i>	2
	<i>Drynaria</i>	3
	<i>Pseudodrynaria</i>	1
	<i>Phymatodes</i>	2
	<i>Crypsinus</i>	1
	<i>Lecanopteris</i>	1
	<i>Goniophlebium</i>	1

Table 1 (Contd)

Families/Subfamilies	Genera	No. of species (incl. subspecies, varieties and hybrids)
THELYPTERIDACEAE	<i>Mesophlebion</i>	1
	<i>Cyclosorus</i>	1
	<i>Sphaerostephanos</i>	2
	<i>Pronephrium</i>	2
	<i>Christella</i>	4
	<i>Amphineuron</i>	3
DENNSTAEDTIACEAE		
Dennstaedtioideae	<i>Microlepia</i>	3
Lindsaeoideae	<i>Lindsaea</i>	7
	<i>Tapeinidium</i>	1
Davallioideae	<i>Davallia</i>	4
	<i>Humata</i>	3
Oleandroideae	<i>Nephrolepis</i>	3
	<i>Oleandra</i>	1
Pteridioideae	<i>Pteris</i>	7
	<i>Acrostichum</i>	2
	<i>Stenochlaena</i>	1
Asplenoideae	<i>Asplenium</i>	9
Blechnoideae	<i>Blechnum</i>	1
Lomariopsidoideae	<i>Lomariopsis</i>	1
	<i>Elaphoglossum</i>	1
	<i>Bolbitis</i>	4
Dryopteridoideae	<i>Polystichum</i>	1
Tectarioideae	<i>Tectaria</i>	5
	<i>Cyclopeltis</i>	1
	<i>Arcypteris</i>	1
	<i>Ctenitis</i>	2
Athyrioideae	<i>Diplazium</i>	3
ADIANTACEAE	<i>Ceratopteris</i>	1
	<i>Taenitis</i>	1
	<i>Cheilanthes</i>	1
	<i>Pityrogramma</i>	1
	<i>Doryopteris</i>	1
	<i>Hemionitis</i>	1
	<i>Adiantum</i>	10
	<i>Antrophyum</i>	1
	<i>Vittaria</i>	3
MARSILEACEAE	<i>Marsilea</i>	1
AZOLLACEAE	<i>Azolla</i>	1
Total number: 59		Total number: 145

## Conclusion

The Langkawian fern flora consists of some 134 species, 2 subspecies, 8 varieties and 1 hybrid representing about 29% of the total number of species found in Peninsular Malaysia, and comprising diverse elements of Malesia, Indochina, India, and Tropical America (introduced).

The introduced elements (some escaped from cultivation and successfully forming part of the natural vegetation, e.g. *Adiantum latifolium*, number only 7 (six of

them belong to the genus *Adiantum*) or 4.8% of the total fern flora of Langkawi. Some of the species which have their centre of distribution in mainland Asia have their southern limit in Langkawi as exemplified by *Platyserium holttumii*, *Pseudodrynaria coronans* and *Tectaria variolosa*. Ferns which may be absent from mainland Malaysia occur in Langkawi due to the preference for a seasonal climate, e.g. *Bolbitis malaccensis* and *Adiantum philippense*. It is apparent from the number of species collected and recorded that Langkawi is rich in its fern flora — thanks to its favourable climate and the varied habitats available.

The stunning beauty of the islands and the cool, refreshing and pollution-free air and sea in Langkawi, have encouraged the authorities to put forward a plan to develop a massive resort city on the north-east portion of the main island, covering c. 566 hectares, centred around a crescent-shaped beach near Tanjung Rhu, as well as at a few other places in this group of islands. The construction of roads, airport, hotels, etc., have already started. The after-effects, such as erosion and landslips, are indeed posing a real threat to the indigenous vegetation not only in terms of area depletion but also extensive degradation and invasion of exotic plants. With these activities, it is becoming apparent that the flora and fauna of Langkawi urgently require investigations before the primary character becomes drastically modified. As survival depends upon preservation of their habitats, conservation of the existing nature reserves is of the utmost importance.

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